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Abstract

CONTROLLED FUSION RESEARCH IN THE U. S. A.

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The major experiments now under way in the United States to study the confinement and heating of plasma are described as well as plans for the future.

In the magnetic mirror program hot plasmas are either produced
(1) by plasma injection followed by magnetic compression (2X)
(2) by trapping ions produced from a beam of neutral atoms (ALICE)
(3) by trapping atomic ions by Lorentz dissociation of H_2^+ (DCX-1) or
(4) by dissociation of H_2^+ in a lithium arc (DCX-2). Results are reported on stabilization by control of the scale and spatial distribution of plasma temperature and density (finite orbit stabilization) and by using complex fields having a closed region of "Minimum B" similar to that of Ioffe.

Other magnetic configurations which utilize "Minimum B" magnetic fields are discussed, such as the caulked cusp and the helixion.

Recent results in the fast magnetic compression experiment (Scylla IV) are presented and a possible attack on the next stage is described.

The Astron facility consisting of a high current electron accelerator (160 Amperes at 4.1 MeV) and a trapping chamber with an axial magnetic field, has been completed. Results of experiments aimed at trapping the electrons in rotating and oscillating orbits to form a cylindrical layer are discussed.

Recent results on a torodial device with pulsed sheared magnetic fields (Levitron) using ion cyclotron heating to discriminate between instability modes are described as well as theoretical results on an $\int dl/B$ stable torodial configuration with periodic multipole structure.

The research program of the Model C stellarator using ohmic heating and various types of ion heating is discussed. Observations indicate that a pure 50 eV plasma can be produced by this technique and that a close approach to mechanical and thermal equilibrium can be achieved. The use of the divertor is discussed as well as the results on measured power radiated, energies required for ionization and heating, and power balance studies.

Hot electron plasma experiments are described in which a steady state has been maintained with the ratio of plasma pressure to magnetic field pressure, β equal to 0.3.

Also described is: supporting research on the performance of high velocity hydromagnetic guns and the behavior of the vacuum deuterium arc.

Programs in controlled fusion under way in industrial laboratories, including General Dynamics and General Electric, are discussed as well as the latest results obtained on fast magnetic compression in the Naval Research Laboratory. A brief survey of the plasma research at Massachusetts Institute of Technology, Stanford University, New York University, and the University of California at San Diego is presented.